How the bank's capitalization and environment influence its interest and liquidity risk

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Abstract

This paper examines the effect of capitalization, competition and wealth of the region on the bank's level of interest rate risk. Our measure for interest risk - the present value loss caused by 200 basis points interest shock – is based on the detailed duration structure of future cash flows of 50 German saving banks. We find that saving banks in underdeveloped regions conduct more maturity transformation respectively interest risk probably to exploit their full risk bearing ability which is not stressed by high credit risk. In contrast, saving banks in a highly competitive environment take a lower interest risk, not investing the money of their rather disloyal clients long-term. Well capitalized saving banks have a higher level of maturity transformation because of their higher risk bearing capacity. We compare our interest measure with the BB measure – a liquidity risk measure - and clarify thereby differences between interest and liquidity risk.

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1 Introduction

Maturity transformation, that is the funding of long-term loans with short-term deposits, has traditionally been a key profit driver of the banking business. Given an upward sloped yield curve, a higher maturity spread between assets and liabilities increases a bank's expected returns from its lending business but at the same time entails higher risks. Given this risk-reward tradeoff, the degree of maturity transformation varies substantially across banks. In this paper, we analyze how the degree of maturity transformation depends on a bank's capitalization, the wealth of its region and its level of competition. Furthermore we clarify the difference between interest and liquidity risk using different measures.

We find a higher degree of maturity transformation for banks in underdeveloped regions and a lower level of maturity transformation for saving banks in a highly competitive region. Saving banks in underdeveloped regions have a higher level of maturity transformation because of a higher average duration of assets – taking more interest risk as they have a predetermined low credit risk. Saving banks in a highly competitive environment have a lower average duration of assets – not investing the money of their rather disloyal clients long-term. Not surprisingly well capitalized saving banks have a higher level of maturity transformation because of their higher risk bearing capacity.

Our analysis is based on a sample of 50 German saving banks, for which we have the detailed duration structure of future cash flows – - we know for all future cash flows of our banks their duration in x-years for all x. To the best of our knowledge this data quality is unique. This is very important as there are few studies with a good interest measure (Entrop, Memmel, Wilkens and Zeisler, 2008 and Memmel, 2011), as accurate interest data is rarely available. As our paper shows plausible results for banks in underdeveloped regions, in a highly competitive environment or with a high capitalization, we assume that our results are transferable on the remaining German saving banks and also on saving banks outside of

Germany. Our results are essential to understand which saving banks take a higher interest risk and why they do it.

But why should we research more about interest risk? First, there are like mentioned above few studies with good interest data, as an accurate measure for interest risk cannot be calculated by balance sheet data. Second, the current low interest policy endangers banks which are specialized on maturity transformation. The results of our paper indicate for example that especially saving banks in underdeveloped regions have to find new profit sources it this low interest policy is not be changed in the near future. Third, maturity transformation strengthened the financial crisis. If many deposits are withdrawn in a short time – which happened in the financial crisis - the affected banks have to sell their long-term securities or loans, which is not possible or only feasible making high losses.

To identify the causal effect of a) the wealth of the bank's region, b) competition and c) capitalization on the level of maturity transformation we regress the present value loss caused by a 200 basis points interest shock on the measure for a), b) or c), a set of control variables and time dummies. As the measures for wealth of the bank's region and competition do not have enough within variation we cannot use in that cases bank fixed effects, but show our regressions with 1) robust standard errors and 2) clustering on bank level (Petersen, 2009). For capitalization we add bank fixed effects.

Concerning the analysis with capitalization we also have an endogeneity problem, as the level of interest risk could have an effect on the capitalization of the bank. To mitigate that endogeneity problem we additionally present results with lagged values of the explanatory variable.

The remainder of the paper is structured as follows. Section 2 provides the theoretical background for our analysis, section 3 gives a literature survey and section 4 contains the

hypotheses development. Section 5 describes the data including our proxy variables for interest risk and presents descriptive statistics. Section 6 presents the results, section 7 shows the robustness tests and section 8 concludes.

2 Theoretical Background

2.1 German Banking System

To understand our results better it is useful to explain the characteristics of the German banking system in more detail. The German banking system consists of three groups, saving banks, cooperative banks and private banks. This structure is unique. Cooperative and saving banks are generally small and should act only in their region. The two latter bank groups have a large net of small stores in all parts of Germany and intend to have a long and multisided relationship with their clients. Because of the high percentage of saving and cooperative banks in Germany, important features of the German banking system are consequently narrower banks-clients-relations and longer relationships. Cooperative and saving banks should guarantee credits for small corporate clients ("Mittelstand") and private clients and should not invest in high-risk securities. Private banks are on the average bigger than cooperative banks, have a smaller net of stores, are only present in well developed regions, invest more in high-risk securities and tend to have bigger credit receivers.

2.2 Maturity transformation

In this section we want to explain maturity transformation in greater detail. To say it simply, banks lend money long-term (credits/assets), which causes future incoming cash flows and borrow it short-term (deposits/liabilities), which leads to future outgoing cash flows. As the

yield curve has normally an upward slope maturity transformation implies profits for the bank.

On the basis of the future cash flows of a bank a good method to calculate the interest risk of a bank is to calculate the present value loss of the future cash flows if there is an interest shock of plus or minus x basis points. Thereby German banks have to report to the Bundesbank the present value loss caused by a 200 basis points shock. Normally an interest shock of plus x basis points leads to a present value loss of future cash flows, an interest shock minus x basis points causes a present value win of future cash flows. Mathematically this is caused – assuming a bank lending long-term and borrowing short-term and a positive interest shock - as the present value of future incoming cash flows is reduced more than the present value of future outgoing cash flows by a higher yield as the duration of the incoming cash flows (assets) is higher than the average duration of the future outgoing cash flows (liabilities). So the difference between the present value of future incoming cash flows and the present value of future outgoing cash flows, the future profit of the bank, is lower after an interest shock plus x basis points.

For our 50 banks there were only four present value losses – always seen as present value of incoming cash flows minus present value of outgoing cash flows - in six years triggered by an interest shock minus x basis points. The other present value losses were caused by interest shock plus x basis points. The four present value losses were also in absolute terms so marginally that we can assume that interest risk for our saving banks is triggered by a positive shock.

As interest risk arises by different durations of assets and liabilities it is obvious that interest risk and liquidity risk are often positively correlated. However some asset types generate a high interest rate risk but a relatively low liquidity risk. For example long-term securities with a fixed yield, which are exchange-traded, are positively correlated to interest risk, but

negatively correlated to liquidity risk as they could be sold easily – of course generating a loss.

2.3 Maturity transformation and credit business as sources of risk and profit

To make profit every bank has to take risk. The two main sources of risk for saving banks are maturity transformation and credit business, as saving banks rarely invest in high-risk securities. At this step it is essential to know if maturity transformation and credit business are completely independent or if they are connected to each other. As mentioned above a higher level of maturity transformation is caused among other things by a higher average duration of assets. So it is obvious to assume that a bank with many credit receivers, who demand credits with a long period, tend to have a higher level of maturity transformation. So the number of credits, the credit volume and the credit period have an influence on the level of maturity transformation.

Nevertheless a bank can influence its maturity transformation with swaps, long-term or short-term securities and the duration of its liabilities. We conclude that there is a relationship between credit business and maturity transformation, but that a bank can shape its maturity transformation independent of its scale of credit business.

There is one important difference between the two most important risk types of saving banks. As saving banks have to comply with the regional principle – they should do only business in their region – their credit risk is relatively predetermined by its region and cannot be changed quickly. In contrast to that, interest risk can always be adjusted rapidly by closing swaps. Consequently saving banks adapt their overall risk with the interest risk.

It is obvious how profits evolve from maturity transformation respectively credit business. If a bank earns a high interest because of long-term assets and has to pay a low interest for short-

term liabilities, this generates a profit as long as the yield curve keeps upward. Credit business generates a profit as long as credit losses are smaller than the credit margin.

However every source of profit has its risk side. The risks of the credit business are apparent - can a credit receiver pay its interest and the credit back? But what are the risks of maturity transformation? We want to describe two risk scenarios if a bank borrows short-term and lends long-term – the typical form of maturity transformation for a bank. First it is apparent that if the yield curve turns and gets inverse the bank is confronted with losses as it has to pay a high interest and earn a low interest. The second scenario is if the short-term and the long-term interest rise the same. For example if a bank has to pay a short-term interest of 2% and earns a long-term interest of 4% and both interest rates increase in short period about 4%. Now the bank has to pay a short-term interest of 6%, but still earns the first years a long-term interest of 4% and consequently makes losses.

3 Literature survey

3.1 Literature survey

The most papers about maturity transformation or liquidity creation – interest risk and liquidity risk are often regarded as related risk types as they mostly are positively correlated like mentioned in the theoretical background section and also shown empirically for Italian banks by Baldan, Zen and Rebonato (2012) - use as measure to describe it rather inaccurate but good available data. For example authors often employ the BB measure developed by Berger and Bouwman (2009), which is calculated by balance sheet data, or the sensitivity of bank stock returns to changes in interest rates (e.g. Ballester, Ferrer, Gonzales and Soto, 2009 and Fraser, Madura and Weigand, 2002). The BB measure is in the first place a measure for liquidity risk, but often used as an indicator for interest risk. However a good measure for

liquidity risk does not have to be a good measure for interest risk and vice versa like seen in the example with exchange-traded long-term securities with a fixed yield in section 2.

A very accurate measure for maturity transformation respectively interest risk is used in Entrop, Memmel, Wilkens and Zeisler (2008) and Memmel (2011). In the two latter papers the present value loss of a 200 basis points interest shock for a bank – which we described in section 2 - is employed. To the best of our knowledge these two papers are the only studies with accurate interest risk data except our work.

Moreover there is much literature concerning risk taking and competition respectively capitalization of banks. Because of brevity, we mention only three studies concentrating on the relationship between liquidity creation and capitalization respectively competition. Berger and Bouwman (2009) find that the relationship between capital and liquidity creation – measured by the original BB measure - is positive and significant for large banks, insignificant for medium banks, and negative and significant for small banks. Moreover Berger, Bouwman, Kick and Schaeck (2012) show with a slightly changed BB measure that regulatory interventions and capital support are associated with significant reductions in liquidity creation. Rauch, Steffen, Hackethal and Tyrell (2011) detect no relationship between competition, measured by the Herfindahl index, and liquidity creation, measured by a maturity adjusted BB measure.

There is a further branch of literature regarding the relationship between maturity transformation and bank characteristics. Gatev, Schuermann and Strahan (2009) show that transaction deposits help banks hedge liquidity risk from unused loan commitments. Entrop, Memmel, Wilkens and Zeisler (2008) find that bigger banks perform more maturity transformation and that saving banks and cooperative banks have a higher interest risk. Ballester, Ferrer, Gonzales and Soto (2009) detect with a Spanish dataset that maturity transformation is positively related with bank size, derivative activities and loans to total

assets. In contrast to that, the proportion of deposits to total assets is according to the results of Ballester, Ferrer, Gonzales and Soto (2009) negatively related to the level of bank's interest rate risk. Ballester, Ferrer, Gonzales and Soto (2009) use however a weak measure – sensitivity of bank stock returns to changes in interest rates. These results would suggest that banks in well developed regions, which are on the average bigger and have a higher ratio of loans to total assets, have a higher level of maturity transformation. However we find in our dataset that banks in underdeveloped regions perform more maturity transformation.

Finally some authors regard the relationship between interest risk and credit risk or liquidity risk and credit risk. This relationship is important for our paper as credit and interest risk – respectively liquidity risk - are the two most important risk types for saving banks. Allesandri and Drehmann (2010) develop a framework where credit and interest risks are analysed jointly. Imbierowicz and Rauch (2014) show that that liquidity and credit risk both contribute to default risk but are not jointly managed. Cornett, McNutt, Strahan and Tehranian (2010) find that banks holding more illiquid assets on their balance sheets, increased asset liquidity and reduced lending during the financial crisis.

The contribution of our paper is to use a very accurate measure for maturity transformation – similar to the one used by Entrop, Memmel, Wilkens and Zeisler (2008) and Memmel (2011) – and presenting new insights what kind of saving banks take a higher interest risk. This is a topic of current importance as the low interest policy endangers banks which are specialized on maturity transformation. Furthermore we compare our results to the more often used, as better available because computable by balance sheet data, BB measure (Berger and Bouwman, 2009), also demonstrating the difference between liquidity and interest risk.

4 Hypotheses development

4.1 Saving banks in underdeveloped regions

As mentioned before every saving bank has to comply with the so called regional principle - they should do only business in their region. Consequently saving banks in underdeveloped regions have a predetermined low credit risk. However every bank hast to take risk to make profits. As a saving bank has only two major risk types – interest and credit risk - we suppose that saving banks in underdeveloped regions peform more maturity transformation to be profitable. Furthermore they could cope with more interest respectively liquidity risk as their risk bearing capacity is hardly stressed by credit risk and consequently it might be the case that a low level of credit risk incentivizes managers to assume higher liquidity risks (Imbierowicz and Rauch, 2014).

H1: Saving banks in underdeveloped regions take a higher interest risk.

4.2 Saving banks in a highly competitive environment

Saving banks in a highly competitive environment are characterized by rather disloyal clients because of the intense competition (e.g. Bloemer, Ruyter and Peeters, 1998). The money of these disloyal clients cannot be invested long-term on the asset side as the probability that it is withdrawn is too high. As maturity transformation develops among other things by a long-term asset side we assume that saving banks in a highly competitive environment take less interest risk.

H2: Saving banks in a highly competitive environment take less interest risk.

4.3 Well capitalized saving banks

It is obvious to suppose that well capitalized saving banks invest in riskier assets (e.g. Lehar 2005) or take a higher interest risk level because of their higher risk bearing capacity.

H3: Well capitalized saving banks take more interest risk.

5 Data

5.1 Data sources

Our dataset consists of 50 German banks in the time period from 2006 to 2010. These 50 banks represent all the saving banks of two neighboring German states, Hesse and Thuringia, and belong without exception to the same saving union, the Sparkassen- und Giroverband Hessen Thüringen. Consequently our 50 savings banks form a homogeny group. In our data period there was except one consolidation in 2006 no change in the number of banks. As we have 20 quarters and 50 banks our regressions contain 998 observations, as two observations are missing because of the mentioned consolidation. Moreover there are sufficient well and poorly capitalized as enough saving banks in underdeveloped and well developed regions in our sample. Also we have sufficient saving banks in a highly competitive environment as saving banks in a lowly competitive environment in our dataset. Hence our sample is suitable for our targeted analysis.

5.2 Measures

For the level of maturity transformation we use the detailed duration structure of future cash flows. With the help of these cash flows we calculate the present value loss of the future cash flows if there is an interest shock of plus or minus x basis points as the main measure for the

level of maturity transformation. Hereby we compute different shock and interest scenarios. We use rising, falling and constant interest shocks dependent on the maturity bucket of the cash flows. Furthermore we employ a constant interest and the historical interest rate as discount rate. For all these scenarios the results keep robust. In the results shown in the paper we use the historical interest rate as the discount rate and a shock of 200 basis points. The present value loss is scaled by equity and in a robustness test by total assets. Furthermore we compute the average duration of assets and the average duration of liabilities in accord with the Macaulay duration formula.

For the wealth of the region we use two different measures. On the one hand we have the gross value added per capita; on the other hand we take the purchasing power per capita. For competition we also have two measures. The first one is the number of institutes of the saving bank in its region divided by the number of other institutes in that region. The second measure is the number of competitive banking groups in that region. Here we differentiate between the following four groups: Cooperative banks, private banks, post banks and other banks. Our measure for capitalization is calculated by equity plus hidden reserves minus hidden burdens and all this divided by total assets. In our robustness test we use just the equity ratio as the measure for capitalization.

The definitions of the different measures respectively variables in this paper are summed up in table 1.

[Table 1]

5.3 Summary statistics

To get an impression of the measures mentioned above we give some descriptive statistics.

[Table 2]

The highest ratio present value loss of future cash flows to equity in the sample accounts for 59.7%, the lowest 0.9% and the average is 25.5%. The highest duration of future incoming cash flows in the sample is 6.1 years, the lowest 1.5 years and the average lies with 3.8 years. The highest duration of future outgoing cash flows accounts for 4.8 years, the minimum is 0.8 years and the average amounts to 2.2 years. Consequently, the mean difference between the duration of the future incoming cash flows and the duration of the future outgoing cash flows is 1.6 years which means that our saving banks practice maturity transformation. In our data period the mean difference between the duration of the future incoming cash flows and the duration of the future outgoing cash flows changed from 1.9 years in 2006 to 1.5 years in 2010.

The highest gross value added per capita of a region of a saving bank in the sample is EUR 63,413, the lowest accounts for EUR 10,222 and the average amounts to EUR 23,150. The maximum purchasing power per capita of a region of a saving bank in our dataset is EUR 28,038, the minimum amounts to EUR 12,867 and the mean is EUR 18,429. The maximum capitalization of a saving bank in our dataset is 16.8%, the minimum 3.6% and the mean accounts for 9.2%. The highest value of competition measure one is in the sample is 3.3, the lowest 0.8 and the average lies with 1.6. The highest value of competition measure two accounts for 4, the minimum is 2 and the average amounts to 3.6.

Finally we present some simple correlations. In the first column of table 3 you see that credit risk – measured by risk weighted assets to total assets – is like expected positively correlated to the level of development of the region.

[Table 3]

For our competition measures the correlation is relatively low and for capitalization we find a negative correlation, which means that the well capitalized banks have a rather low credit risk in our dataset.

Out of column 2 you can withdraw the correlations between interest risk and our measures for development of the region, competition and capitalization. Column 2 supports our three hypotheses of section 4.

6 Results

6.1 Saving banks in underdeveloped regions

In our paper we want to show that saving banks in underdeveloped regions perform more maturity transformation, while saving banks in a highly competitive environment have less interest risk. Furthermore we want to reveal that well capitalized banks perform more maturity transformation. To analyze the effect for underdeveloped saving banks we use the following OLS-regression:

$$InterestRisk_{i,t} = \propto + \beta_1 * WealthOfTheRegion_{i,t} + \beta_j * ControlVariables_{i,t} + \gamma_1 * PreCrisis + \gamma_2 * Crisis + \varepsilon_{i,t} \qquad (1)$$

The level of maturity transformation is measured by the present value loss of the future cash flows if there is an interest shock of plus or minus x basis points scaled by equity of the saving bank. We use as mentioned above different shock and interest scenarios. We calculate rising, falling and constant interest shocks dependent on the maturity bucket of the cash flows. Furthermore we take a constant interest and a historical interest as discount rate scenarios. For all these scenarios the results keep robust. In the results shown in the paper we take the historical interest rate and a shock of 200 basis points. As a further robustness test we scaled

the interest shock by total assets instead of equity – the results keep robust and are not shown in this paper because of brevity.

For the level of wealth in a saving bank's region we deploy as measure the gross value added per capita respectively the purchasing power per capita. Furthermore we control for the variables total assets (log), loans to total assets, deposits to total assets and return on assets as bank characteristics. To control for different interest conditions we include the short-term interest rate (6 month interest rate) and the difference between the long-term (10 year interest rate) and short term interest rate as further control variables. Finally we take into consideration economy indicators – Dax (German stock index) and GDP - and pre-crisis and crisis as time dummies for the financial crisis. The post-crisis time dummy is not included in the regression equation to avoid multicolinearity. For all regressions we show the results with a) robust standard errors and b) clustering on bank level. We do not use bank fixed effects as there is not enough within variance in the explanatory variable gross value added per capita respectively purchasing power per capita.

Table 4 shows in column 1 and column 3 the results of equation 1 with robust standard errors - there is in both cases a significant negative effect for saving banks in well developed regions.

[Table 4]

In column 2 and 4 we cluster on bank level. For the measure gross value added per capita the effect keeps significant. These results show that our saving banks in underdeveloped regions perform more maturity transformation and that hypothesis 1 is accepted. The most significant control variable of table 1 is total assets (log) with a highly negative sign in both regressions with robust standard errors. That does not surprise as the saving banks in underdeveloped regions are on average the smaller institutes in our dataset.

To use completely our data material, it would be interesting to see if the higher maturity transformation for saving banks in underdeveloped regions comes from a higher average duration of future incoming cash flows or a lower duration of future outgoing cash flows. To test the latter we replace the present value shock of equation 1 by a) the average duration of assets and b) the average duration of liabilities. Table 5 shows the results with the dependent variable average duration of assets.

[Table 5]

According to table 5, saving banks in underdeveloped regions have a significantly higher duration of incoming cash flows. The other minor measure for maturity transformation, the average duration of liabilities, is insignificant and is not shown in this paper.

To sum up, the higher maturity transformation of saving banks in underdeveloped regions is caused by a higher average duration of assets. We want to reflect why banks in underdeveloped regions have assets with an average longer duration. The asset side of a saving bank is dominated by loans and securities. Saving banks in underdeveloped regions have normally less corporate credit business, which leads to a lower ratio loans to total assets and to a higher ratio securities to total assets, that is at least for our 50 saving banks true. Consequently, we suppose that our saving banks in underdeveloped regions invest in longer securities as the credit business is determined by the customer needs. Unfortunately, we cannot prove that assumption with our data material, as a detailed duration structure of the different types of assets and liabilities is missing.

6.2 Saving banks in a highly competitive environment

To test if saving banks in a highly competitive environment perform more or less maturity

transformation we use the same OLS-regression like in section 6.1 except replacing wealth of the region by competition:

$$InterestRisk_{i,t} = \propto + \beta_1 * Competition_{i,t} + \beta_j * ControlVariables_{i,t}$$
$$+ \gamma_1 * PreCrisis + \gamma_2 * Crisis + \varepsilon_{i,t} \qquad (2)$$

We control again for the variables total assets (log), loans to total assets, deposits to total assets, return on assets, difference between the long-term and short-term interest rate, short-term interest rate, Dax and GDP and use time dummies.

Table 6 shows the results of equation 2 with two different measures for competition, which are described in the data chapter.

[Table 6]

There is a negative significant effect between competition and maturity transformation, which is again measured by the present value loss of the future cash flows scaled by equity, in the regressions with robust standard errors. In column 2 and 4 of the table we cluster on bank level – the relationship keeps significant for one of the two measures. As a further robustness test we scaled the interest shock by total assets instead of equity – the results keep robust and are not shown in this paper because of brevity. Consequently hypothesis 2 is also accepted.

Again we check the significance of our minor measures for maturity transformation - the average duration of assets and liabilities. Table 7 reflects the results with the dependent variable average duration of assets.

[Table 7]

According to that, saving banks in highly competitive regions have a significant lower duration of incoming cash flows. This supports our hypothesis that saving banks in a highly competitive environment does not invest the money of their rather disloyal clients long-term.

The other minor measure for maturity transformation, the average duration of outgoing cash flows, is insignificant and is not shown in this paper.

6.3 Well capitalized saving banks

To test if well capitalized saving banks perform more or less maturity transformation we use the same regression like in section 6.2 except that we replace competition by capitalization and add bank fixed effects as the variable capitalization has enough within variance.

$$InterestRisk_{i,t} = \propto + \beta_1 * CapitalizationOfBank_{i,t} + \beta_j * ControlVariables_{i,t} + \gamma_1 * PreCrisis + \gamma_2 * Crisis + \delta_i + \varepsilon_{i,t} \quad (3)$$

Table 8 shows in column 1 (robust standard errors) and 2 (clustering on bank level) the results of equation 3.

[Table 8]

In column 1 we have a significant positive effect between capitalization and maturity transformation, which is lost when we cluster on bank level. The level of maturity transformation is again measured by the present value loss of the future cash flows if there is an interest shock of plus or minus x basis points scaled by equity of the saving bank. We assume that the positive relationship between capitalization and maturity transformation is more significant when we scale the present value loss caused by an interest shock by total assets instead of equity as well capitalized banks are characterized by definition by a high level of equity. The results of column 3 and 4 of table 8 support that assumption.

Finally we lag the explanatory variable capitalization in column 5 and 6 to mitigate the endogeneity problem. There remains a weakly positive effect for the robust standard errors. These results support the theoretical explanation and our hypothesis 3 that well capitalized

market participants take more risk because they can cope better with losses. The alternative explanation that poorer market participants take a higher risk in a sense of "gamble for resurrection" does not make much sense for our sample as our 50 saving banks are all far away from insolvency.

7 Robustness issues

7.1 BB measure

In our first robustness tests we replace our previous measure for interest risk – the present value loss caused by a 200 basis points interest shock – with the BB measure developed by Berger and Bouwman (2009), as the BB measure should be a good indicator for interest risk, although it is actually a measure for liquidity risk. The BB measure is calculated in three steps. The first step is to classify assets and liabilities as liquid, semiliquid or illiquid. In the second step you assign weights to liquid, semiliquid or illiquid assets and liabilities. Hereby the idea is how much liquidity is created by the bank to the economy. According to Berger and Bouwman (2009) liquidity is created if a bank holds illiquid items (e.g. long-term loans) and grants liquid items (e.g. short-term deposits). Consequently, illiquid assets and liquid liabilities are weighted with +0.5, semi-liquid assets and semi-liquid liabilities with 0 and liquid assets and illiquid liabilities with -0.5. The multipliers are 0.5 so that assuming the short-term deposit and long-term loan have a volume of EUR 1 each, EUR 1 of liquidity would be created by the bank. In table 9 you can find a classification of our assets and liabilities.

[Table 9]

In the third step all the weighted assets and liabilities are added up and normalized by total assets to get the measure for liquidity risk.

In table 10 you see our regression results with the BB measure.

[Table 10]

For wealth of the region and competition we choose each time the more significant measure based on the 200 bp shock regressions, that means gross value added per capita and competition 2. Surprisingly, we get with the BB measure the inversed results for saving banks in undeveloped regions and for well capitalized banks compared to the regressions with the 200 basis points measure. That means that saving banks in underdeveloped regions and well capitalized banks have a lower liquidity risk – measured by the BB measure - but a higher interest risk – measured by the 200 basis points measure.

The results with the BB measure for saving banks in a highly competitive environment are insignificant. Our liquidity risk results for well capitalized banks correspond to the results of Berger and Bouwman (2009), who find a negative relationship between small banks – our banks belong almost without exception to that category - and liquidity risk.

To understand the inversed liquidity and interest risk results for banks in underdeveloped regions respectively well capitalized banks it is necessary to analyze which assets or liabilities classes have a different effect on interest and liquidity risk. At this point we come back to the exchange traded long-term securities with a fixed yield we mentioned in section 2. These securities are positively correlated to interest risk – as they are long-term and have a fixed yield -, but negatively correlated to liquidity risk as exchange traded securities are regarded as liquid assets as they could be sold easily. Consequently we suppose that saving banks in underdeveloped regions and well capitalized saving banks have a significant higher ratio exchange traded securities with a fixed yield to total assets. To prove our assumption we calculate the relevant correlations. We get a correlation of -0.50 between gross value added per capita and the ratio exchange listed securities with a fixed yield to total assets. Between

capitalization and the ratio exchange listed securities to total assets we identify a correlation of 0.52. These results confirm our assumption.

To sum up, our BB measure results show that interest risk and liquidity risk is not in all cases positively correlated. Actually for our dataset, saving banks in underdeveloped regions and well capitalized saving banks have a higher interest risk but a lower liquidity risk, which is probably driven by exchange traded long-term securities with a fixed yield. Consequently liquidity and interest risk should be more differentiated in the literature.

7.2 Further robustness check

As a further robustness check we conclude all our measures, wealth of the region, capitalization and competition, in one regression with the 200 basis points shock. For wealth of the region and competition we choose again the more significant measures gross value added per capita and competition 2. The results are presented in table 12.

[Table 12]

For the regressions with the dependent variable present value loss to equity the results keep robust. If we replace the dependent variable present value loss to equity by the present value loss to total assets our measures remain significant as well and the most significant explanatory variable is capitalization. In sum, our results keep robust when we conclude all our measures in one regression.

8 Conclusion

In our paper we show among other things that saving banks in underdeveloped regions perform more maturity transformation, because they have a higher average duration of their

future incoming cash flows, probably caused by more long-term securities. The theoretical reason that saving banks in underdeveloped regions tend to take more interest risk seems to be their lower credit risk.

Furthermore we show that saving banks in a highly competitive environment perform less maturity transformation as they have a lower average duration of assets. We suppose that these saving banks do not invest the money of their rather disloyal clients long-term.

Moreover we reveal that well capitalized banks perform more maturity transformation. The theoretical reason that saving banks in underdeveloped regions tend to take more interest risk seems to be their higher risk bearing capacity.

Finally we show that saving banks in underdeveloped regions and well capitalized saving banks have a lower liquidity risk, although they have a higher interest risk. The inversed interest and liquidity risk results are presumably driven by exchange listed long-term securities with a fixed yield, which increase interest risk but reduce liquidity risk.

With our paper we add to the existing literature a new and more detailed measure for maturity transformation –the detailed duration structure of future cash flows. Furthermore we show that liquidity and interest risk can be negatively correlated in some cases, and should be more differentiated in the literature.

Future research may extend our analysis by constructing a model which shows the interaction between interest, liquidity and credit risk.

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Table 1: Description of Variables

Variable Name	Unit	Description
Ratio present value loss to equity	%	Present value loss of future cash flows if there is an interest shock of 200 basis points divided by equity
Duration of future incoming/outgoing cash flows	years	Duration of future incoming/outgoing cash flows calculated by the Macaulay duration formula
Gross value added per capita	TEUR	Gross value added per capita of the individual region of a saving banks
Purchasing power per capita	TEUR	Purchasing power per capita of the individual region of a saving banks
Capitalization	%	Equity plus hidden reserves minus hidden burdens divided by total assets
Competition 1	ratio	Number of institutes of saving banks in one region divided by the number of institutes of non-saving banks in that region
Competition 2	ratio	Number of competitive banking groups.
Total assets	TEUR	Total assets
Loans to total assets	%	Loans to total assets
Deposits to total assets	%	Deposits to total assets
Return on assets	%	Return on assets
Yield spread	%	Spread between the 6-month and the 10-years interest
6-month interest	%	6-month interest
GDP	EUR (Bio.)	Gross domestic product of Germany
Dax	index	German share index
Pre-crisis dummy	0/1 dummy	Dummy variable which is 1 before the financial crisis
Crisis dummy	0/1 dummy	Dummy variable which is 1 during the financial crisis

Table 2: Descriptive Statistics

Variable name	Unit	Maximum	Minimum	Mean	Median
Ratio present value loss to equity	%	59.7	0.86	25.5	25.3
Duration of future incoming cash flows	years	6.1	1.5	3.8	3.8
Duration of future outgoing cash flows	years	4.8	0.8	2.2	2.2
Gross value added per capita	EUR	63,413	10,222	23,150	21,028
Purchasing power per capita	EUR	28,038	12,867	18,429	18,298
Capitalization	%	16.8	3.6	9.2	8.9
Competition 1	ratio	3.3	0.8	1.6	1.5
Competition 2	ratio	4	2	3.6	4

Table 3: Correlations

Correlations	Risk weighted assets to total assets	Ratio present value loss to equity
Gross value added per capita	0.18	-0.22
Purchasing power per capita	0.35	-0.21
Competition 1	0.05	-0.19
Competition 2	-0.11	-0.23
Capitalization	-0.21	0.09

Table 4: Maturity transformation in underdeveloped regions (present value shock)

The table reports in column 1 and 3 OLS-regressions with control variables, time dummies and robust standard errors. In column 2 and 4 we additionally cluster on bank level. The regressions include data from 2006 to 2010. The variables are defined as in Table 1. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level and *** = 1%-level.

	Ratio present value loss to equity			
	(1)	(2)	(3)	(4)
Gross value added per capita	-0.0017*** (-5.57)	-0.0017** (-2.13)		
Purchasing power per capita			-0.0095*** (-5.42)	-0.0095 (-1.50)
Total assets (log)	-0.0103*** (-3.45)	-0.0103 (-1.02)	-0.0113*** (-4.32)	-0.0113 (-1.23)
Loans to total assets	0.006 (0.16)	0.006 (0.05)	0.105** (2.49)	0.105 (0.75)
Deposits to total assets	0.0221 (0.49)	0.0221 (0.15)	-0.0531 (-1.09)	-0.0531 (-0.32)
Return on assets	-9.043*** (-4.06)	-9.043* (-1.75)	-6.222*** (-2.75)	-6.222 (-1.13)
Yield spread	7 e-6 (0.00)	7 e-6 (0.00)	-0.0033 (-0.31)	-0.0033 (-0.35)
6-month interest	-0.0061 (-0.60)	-0.0061 (-0.66)	-0.0066 (-0.65)	-0.0066 (-0.70)
GDP	0.0002 (0.14)	0.0002 (0.21)	-0.0003 (-0.33)	-0.0003 (-0.48)
Dax	-4 e-6 (-0.51)	-4 e-6 (-0.89)	-7 e-6 (-0.82)	-7 e-6 (-1.32)
Pre-crisis dummy	0.0059 (0.27)	0.0059 (0.31)	-0.0159 (-0.73)	-0.0159 (-0.70)
Crisis dummy	-0.0038 (-0.04)	-0.0038 (-0.23)	-0.0236 (-0.78)	-0.0236 (-1.22)
Clustering on bank level	N	N	N	Y
Observations	998	998	998	998
Adjusted R^2	0.064	0.064	0.080	0.080

Table 5: Maturity transformation in underdeveloped regions (duration)

The table reports in column 1 and 3 OLS-regressions with control variables, time dummies and robust standard errors. In column 2 and 4 we additionally cluster on bank level. The regressions include data from 2006 to 2010. The variables are defined as in Table 1. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level and *** = 1%-level.

	Duration of future incoming cash flows			
	(1)	(2)	(3)	(4)
Gross value added per capita	-0.0365*** (-14.65)	-0.0365*** (-4.74)		
Purchasing power per capita			-0.0756*** (-5.50)	-0.0756 (-1.53)
Total assets (log)	0.0202 (0.98)	0.0202 (0.29)	-0.104*** (-4.89)	-0.104 (-1.40)
Loans to total assets	1.234*** (3.74)	1.234 (1.14)	1.566*** (4.27)	1.566 (1.34)
Deposits to total assets	0.972*** (3.38)	0.972 (1.18)	0.288 (0.88)	0.288 (0.28)
Return on assets	25.88* (1.78)	25.88 (0.63)	37.49** (2.17)	37.49 (0.76)
Yield spread	0.0096 (0.12)	0.0096 (0.17)	-0.0275 (-0.35)	-0.0275 (-0.44)
6-month interest	-0.0524 (-0.70)	-0.0524 (-0.96)	-0.0736 (-0.95)	-0.0736 (-1.26)
GDP	0.0050 (0.79)	0.0050 (1.27)	0.0029 (0.44)	0.0029 (0.66)
Dax	4 e-5 (0.65)	4 e-5 (1.04)	3 e-5 (0.53)	3 e-5 (0.83)
Pre-crisis dummy	0.261* (1.67)	0.261* (1.68)	0.131 (0.78)	0.131 (0.71)
Crisis dummy	0.182 (0.79)	0.182 (1.31)	0.0559 (0.23)	0.0559 (0.33)
Clustering on bank level	N	Y	N	Y
Observations	998	998	998	998
Adjusted R^2	0.173	0.173	0.101	0.101

Table 6: Maturity transformation of banks in a highly competitive environment (present value shock)

The table reports in column 1 and 3 OLS-regressions with control variables, time dummies and robust standard errors. In column 2 and 4 we additionally cluster on bank level. The regressions include data from 2006 to 2010. The variables are defined as in Table 1. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level and *** = 1%-level.

Ratio present value loss to equity				
	(1)	(2)	(3)	(4)
Competition 1	-0.0257*** (-3.57)	-0.0257 (-1.03)		
Competition 2			-0.039*** (-5.66)	-0.039* (-1.68)
Total assets (log)	-0.0112*** (-3.14)	-0.0112 (-0.85)	0.0009 (0.20)	0.0009 (0.06)
Loans to total assets	-0.0319 (-0.86)	-0.0319 (-0.26)	-0.126*** (-2.85)	-0.126 (-0.83)
Deposits to total assets	0.0092 (0.20)	0.0092 (0.06)	0.0069 (0.15)	0.0069 (0.05)
Return on assets	-10.48*** (-4.57)	-10.48* (-1.92)	-9.177*** (-4.00)	-9.177* (-1.78)
Yield spread	-0.0013 (-0.12)	-0.0013 (-0.14)	-0.0013 (-0.12)	-0.0013 (-0.14)
6-month interest	-0.0079 (-0.77)	-0.0079 (-0.83)	-0.0083 (-0.82)	-0.0083 (-0.88)
GDP	0.0002 (0.25)	0.0002 (0.39)	-0.0003 (0.39)	-0.0003 (0.58)
Dax	-3 e-6 (-0.34)	-3 e-6 (-0.58)	-2 e-6 (-0.24)	-2 e-6 (-0.40)
Pre-crisis dummy	0.0095 (0.44)	0.0095 (0.50)	0.0147 (0.69)	0.0147 (0.73)
Crisis dummy	-0.0011 (-0.04)	-0.0011 (-0.07)	0.0038 (0.13)	0.0038 (0.21)
Clustering on bank level	N	Y	N	Y
Observations	998	998	998	998
Adjusted R^2	0.064	0.064	0.079	0.079

Table 7: Maturity transformation of banks in a highly competitive environment (duration)

The table reports in column 1 and 3 OLS-regressions with control variables, time dummies and robust standard errors. In column 2 and 4 we additionally cluster on bank level. The regressions include data from 2006 to 2010. The variables are defined as in Table 1. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level and *** = 1%-level.

	Duration of future incoming cash flows			
	(1)	(2)	(3)	(4)
Competition 1	-0.311*** (-6.33)	-0.311* (-1.71)		
Competition 2			-0.158*** (-2.59)	-0.158 (-0.67)
Total assets (log)	-0.0715*** (-3.04)	-0.0715 (-0.88)	-0.0827* (-1.81)	-0.0827 (-0.45)
Loans to total assets	0.462 (1.46)	0.462 (0.46)	0.120 (0.30)	0.120 (0.09)
Deposits to total assets	0.755** (2.57)	0.755** (0.87)	0.799*** (2.76)	0.799 (0.95)
Return on assets	0.981 (0.06)	0.981 (0.02)	11.47 (0.63)	11.47 (0.23)
Yield spread	-0.0136 (-0.17)	-0.0136 (-0.23)	-0.0093 (-0.12)	-0.0093 (-0.16)
6-month interest	-0.0861 (-1.11)	-0.0861 (-1.48)	-0.0841 (-1.08)	-0.0841 (-1.48)
GDP	0.0069 (1.05)	0.0069* (1.74)	0.0073 (1.07)	0.0073* (1.69)
Dax	7 e-5 (-0.34)	7 e-5* (1.68)	7 e-5 (1.02)	7 e-5 (1.62)
Pre-crisis dummy	0.334** (2.02)	0.334** (2.18)	0.351** (2.08)	0.351** (2.05)
Crisis dummy	0.236 (0.98)	0.236* (1.72)	0.253 (1.03)	0.253 (1.63)
Clustering on bank level	N	Y	N	Y
Observations	998	998	998	998
Adjusted R^2	0.102	0.102	0.077	0.077

Table 8: Maturity transformation of well capitalized banks

The table reports in column 1, 3 and 5 OLS-regressions with control variables, time dummies, bank fixed effects and robust standard errors. In column 2, 4 and 6 we additionally cluster on bank level. The regressions include data from 2006 to 2010. The variables are defined as in Table 1. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level and *** = 1%-level.

	Present value loss to equity		Present value loss to total assets			
	(1)	(2)	(3)	(4)	(5)	(6)
Capitalization	1.511*** (2.87)	1.511 (1.34)	0.103*** (3.96)	0.103* (1.83)		
Lagged Capitalization					0.0365* (1.70)	0.0365 (0.64)
Total assets (log)	0.0207 (0.23)	0.0207 (0.11)	-0.0095** (-2.24)	-0.0095 (-1.06)	-0.0109*** (-2.72)	-0.0109 (-0.98)
Loans to total assets	-0.211 (-1.41)	-0.211 (-0.63)	-0.0076 (-1.13)	-0.0076 (-0.52)	0.0103 (1.56)	0.0103 (0.66)
Deposits to total assets	-0.0029 (-0.04)	-0.0029 (-0.02)	0.0006 (0.17)	0.0006 (0.10)	0.0043 (1.45)	0.0043 (0.78)
Return on assets	-5.713** (-1.97)	-5.713 (-0.93)	-0.334*** (-2.65)	-0.334 (-1.30)	-0.0686 (-1.53)	-0.0686 (-0.89)
Yield spread	0.002 (0.28)	0.002 (0.32)	5 e-5 (0.14)	5 e-5 (0.15)	0.0002 (0.64)	0.0002 (0.63)
6-month interest	-0.0073 (-1.09)	-0.0073 (-1.18)	-0.0002 (-0.49)	-0.0002 (-0.52)	0.0003 (1.16)	0.0003* (1.81)
GDP	0.0009 (1.53)	0.0009 (1.31)	8 e-6 (0.28)	8 e-6 (0.24)	-7 e-5*** (-2.73)	-7 e-5*** (-2.96)
Dax	3 e-7 (0.06)	3 e-7 (0.07)	-3 e-7 (-1.01)	-3 e-7 (-1.13)	-6 e-7*** (-2.71)	-6 e-7*** (-3.00)
Pre-crisis dummy	0.042** (2.44)	0.042 (1.52)	0.0004 (0.45)	0.0004 (0.28)	-0.003*** (-3.36)	-0.003*** (-2.94)
Crisis dummy	0.0306 (1.43)	0.0306 (1.19)	6 e-5 (0.06)	6 e-5 (0.05)	-0.003*** (-3.03)	-0.003*** (-2.72)
Bank fixed effects	Y	Y	Y	Y	Y	Y
Clustering on bank level	N	Y	N	Y	N	Y
Observations	998	998	998	998	998	998
Adjusted R^2	0.028	0.028	0.078	0.078	0.114	0.114

Table 9: BB measure calculation

The table shows the assets and liabilities of our dataset and our classification in illiquid, semi-liquid and liquid items.

Assets

Illiquid assets (weight +0.5)	Semi-liquid assets (weight 0)	Liquid assets (weight -0.5)
Commercial loans	Consumer loans	Cash
Non exchange listed securities	Loans to banks	Overnight money
	Government loans	Exchange listed securities

Liabilities

Liquid liabilities (weight +0.5)	Semi-liquid liabilities (weight 0)	Illiquid liabilities (weight -0.5)
Overnight money	Saving deposits	Equity
Transaction deposits	Time deposits	Emissions
	Liabilities to banks	

Table 10: BB measure regressions

The table reports in column 1, 3 and 5 OLS-regressions with control variables, time dummies and robust standard errors. In column 2, 4 and 6 we additionally cluster on bank level, the regression in column 5 and 6 also include bank fixed effects. The regressions include data from 2006 to 2010. The variables are defined as in Table 1. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level and *** = 1%-level.

	BB measure					
	(1)	(2)	(3)	(4)	(5)	(6)
Gross value added per capita	0.0029*** (8.04)	0.0029** (2.01)				
Competition 2			-0.0015 (-0.22)	-0.0015 (-0.05)		
Capitalization					-1.047*** (-4.74)	-1.047* (-1.70)
Total assets (log)	0.0252*** (8.40)	0.0252* (2.00)	0.0406*** (7.99)	0.0406* (1.88)	0.140** (2.56)	0.140 (0.85)
Loans to total assets	0.708*** (22.85)	0.708*** (5.96)	0.762*** (19.56)	0.762*** (4.90)	0.658*** (8.18)	0.658*** (2.50)
Deposits to total assets	0.172*** (4.28)	0.172 (1.05)	0.182*** (4.59)	0.182 (1.14)	0.439*** (14.01)	0.439*** (5.26)
Return on assets	-20.04*** (-9.97)	-20.04*** (-2.92)	-18.64*** (-8.47)	-18.64** (-2.55)	-1.820 (-1.61)	-1.820 (-0.66)
Yield spread	-0.0207** (-2.35)	-0.0207*** (-2.90)	-0.0194** (-2.12)	-0.0194*** (-2.86)	-0.007* (-1.80)	-0.007* (-1.75)
6-month interest	-0.0215** (-2.54)	-0.0215*** (-3.00)	-0.0193** (-2.22)	-0.0193*** (-2.83)	-0.0066** (-2.00)	-0.0066* (-1.96)
GDP	-7 e-5 (-0.10)	-7 e-5 (-0.24)	-0.0002 (-0.28)	-0.0002 (-0.67)	-0.0007*** (-2.72)	-0.0007** (-2.49)
Dax	6 e-6 (0.81)	6 e-6 (1.62)	4 e-6 (0.54)	4 e-6 (1.16)	-2 e-6 (-0.74)	-2 e-6 (-0.87)
Pre-crisis dummy	-0.023 (-1.31)	-0.023** (-2.18)	-0.0282 (-1.56)	-0.0282** (-2.66)	-0.0354*** (-4.98)	-0.0354** (-2.60)
Crisis dummy	-0.0312 (-1.23)	-0.0312*** (-3.23)	-0.0349 (-1.35)	-0.0349*** (-3.56)	-0.0398*** (-4.38)	-0.0398*** (-2.98)
Bank fixed Effects	N	N	N	N	Y	Y
Clustering on bank level	N	Y	N	Y	N	Y
Observations	998	998	998	998	998	998
Adjusted R^2	0.596	0.596	0.570	0.570	0.548	0.548

Table 11: Further robustness check

The table reports in column 1 and 3 OLS-regressions with control variables, time dummies and robust standard errors. In column 2 and 4 we additionally cluster on bank level. The regressions include data from 2006 to 2010. The variables are defined as in Table 1. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level and *** = 1%-level.

	Present value loss to equity		Present value loss to total assets	
	(1)	(2)	(3)	(4)
Gross value added per capita	-0.0021*** (-5.58)	-0.0021* (-1.82)	-3 e-5* (-1.93)	-3 e-5* (-0.62)
Competition 2	-0.0493*** (-6.76)	-0.0493** (-2.04)	-0.0027*** (-7.74)	-0.0027** (-2.31)
Capitalization	0.298* (1.81)	0.298 (0.54)	0.133*** (13.11)	0.133*** (3.64)
Total assets (log)	0.0188*** (3.65)	0.0188 (1.15)	0.0009*** (3.48)	0.0009 (1.07)
Loans to total assets	-0.101** (-2.32)	-0.101 (-0.69)	0.002 (0.98)	0.002 (0.30)
Deposits to total assets	0.0097 (0.22)	0.0097 (0.06)	-0.0004 (-0.20)	-0.0004 (-0.06)
Return on assets	-10.80*** (-3.76)	-10.80 (-1.51)	-0.348** (-2.57)	-0.348 (-0.96)
Yield spread	-0.0007 (-0.06)	-0.0007 (-0.07)	8 e-5 (-0.29)	8 e-5 (0.16)
6-month interest	-0.0075 (-0.75)	-0.0075 (-0.77)	-0.0002 (-0.30)	-0.0002 (-0.31)
GDP	0.0004 (0.45)	0.0004 (0.57)	2 e-5 (0.46)	2 e-5 (0.61)
Dax	-2 e-6 (-0.28)	-2 e-6 (-0.38)	-2 e-7 (-0.43)	-2 e-7 (-0.62)
Pre-crisis dummy	0.0167 (0.78)	0.0167 (0.71)	0.0009 (0.86)	0.0009 (0.78)
Crisis dummy	0.0065 (0.22)	0.0065 (0.31)	0.0006 (0.41)	0.0006 (0.58)
Clustering on bank level	N	Y	N	Y
Observations	998	998	998	998
Adjusted R^2	0.105	0.105	0.314	0.314

Appendix: List of saving banks in the sample

Name of saving bank	**German state**
Altenburger Land	Thuringia
Arnstadt-Ilmenau	Thuringia
Bad Hersfeld	Hesse
Battenberg	Hesse
Bensheim	Hesse
Borken	Hesse
Darmstadt	Hesse
Dieburg	Hesse
Dillenburg	Hesse
Eichsfeld	Thuringia
Felsberg	Hesse
Frankfurt	Hesse
Fulda	Hesse
Gelnhausen	Hesse
Gera-Greiz	Thuringia
Gießen	Hesse
Gotha	Thuringia
Grebenstein	Hesse
Groß-Gerau	Hesse
Grünberg	Hesse
Hanau	Hesse
Hildburghausen	Thuringia
Jena	Thuringia
Kassel	Hesse
Kyffhäuser	Thuringia
Langen-Seligenstadt	Hesse
Laubach	Hesse
Limburg	Hesse
Marburg-Biedenkopf	Hesse
Mittelthüringen	Thuringia
Nassauische	Hesse
Nordhausen	Thuringia
Oberhessen	Hesse
Odenwaldkreis	Hesse
Offenbach	Hesse
Rhön-Rennsteig	Thuringia
Saale-Orla	Thuringia
Saalfeld-Rudolstadt	Thuringia
Schlüchtern	Hesse
Schwalm-Eder	Hesse
Schwalmstadt	Hesse
Sonneberg	Thuringia
Starkenburg	Hesse
Taunus	Hesse
Unstrut Hainich	Thuringia
Waldeck-Frankenberg	Hesse
Wartburg	Thuringia
Weilburg	Hesse
Werra-Meißner	Hesse
Wetzlar	Hesse